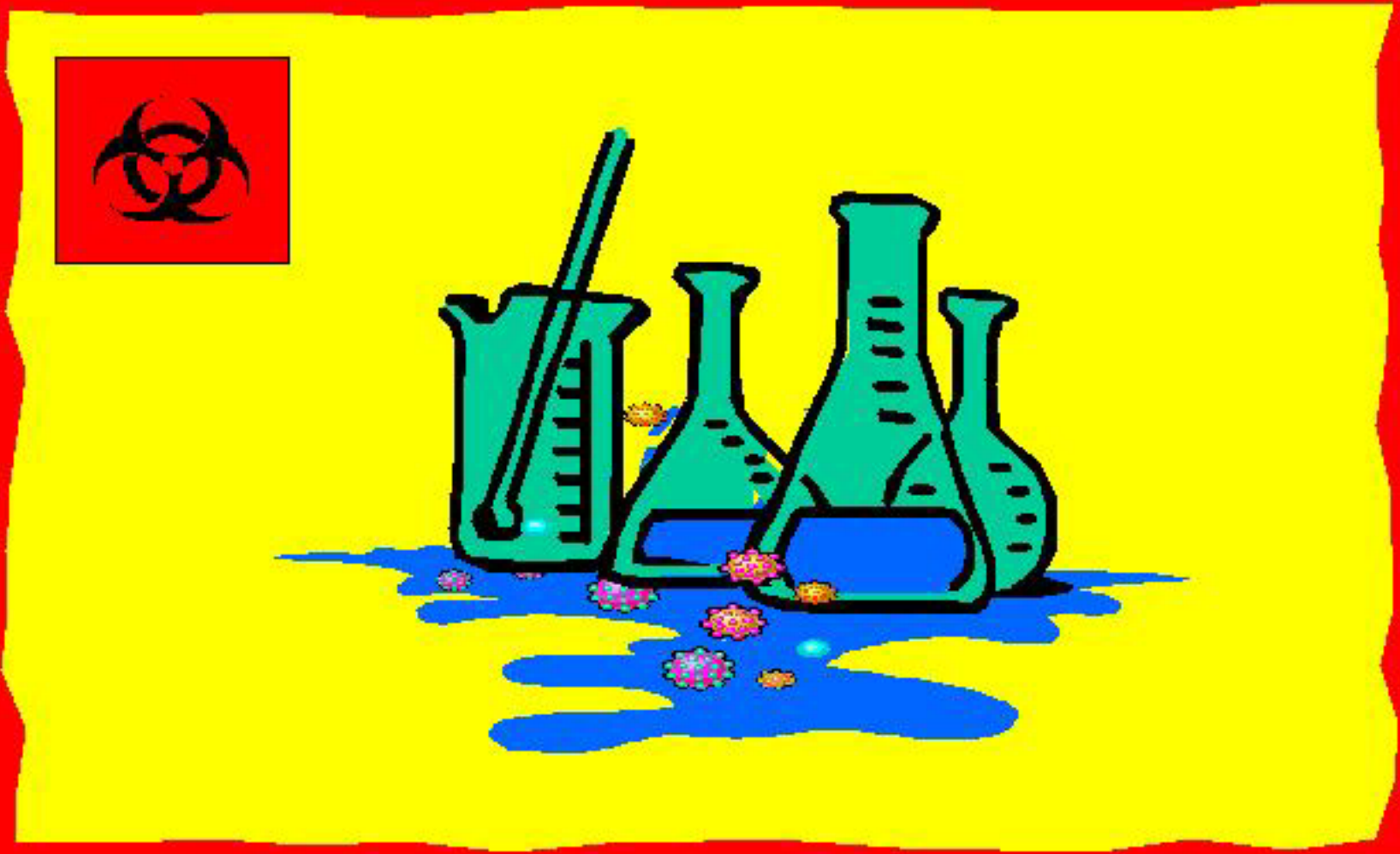
Office of Health and Safety

2002

Biological Spill Response Guide



Laboratory Safety Branch

Emergency Contact Numbers

1. If needed, call for fire or ambulance assistance: **9-911**

2. Notify immediate supervisor of incident as soon as possible. Then call your Division Safety Specialist _____ at #_____ or pager #_____ .

If not available, contact:

LSB secretary	(404) 639-2754
Chief, Operation Section	(404) 639-2753
Branch Chief, LSB	(404) 639-3238
Chief, Radiation Section	(404) 639-3145
24 hour Emergency Pager	(404) 278-1307
Environmental Health and Safety Branch	(404) 639-3112
24 hour Emergency Pager	(404) 896-5948
Occupational Health Clinic	(404) 639-3385
After hours- Phyllis Kozarsky, MD	(404) 321-0111

Introduction

This Biological Spill Response Guide is intended to serve as a quick reference for employees that work with infectious agents. It should not be used as a substitute for assistance from the Laboratory Safety Branch (LSB), Office of Health and Safety (OHS), under circumstances where additional resources, expertise, or personal protective equipment may be necessary. All spills must be reported to the LSB. The LSB will file a report for every spill.

Consideration must be given to the volume of infectious agent involved in the spill or release, the agent, its transmission potential, and the normal route of entry for infection.

Following the spill response guide will help ensure the health and safety of persons when an emergency occurs. This guide is not intended to be all inclusive in meeting the requirements of an emergency response program, but rather is designed to provide a readily available approach to managing spills involving biological agents at different biosafety levels.

Should the need arise to evacuate a building, OHS officials in conjunction with Occupant Emergency Program (OEP) coordinators and monitors will assist with the evacuation. All facilities are equipped with audible alarm systems. In addition, some facilities are equipped with a public address system (PA) which may be used to broadcast emergency announcements.

It should also be noted that CDC laboratories have single pass directional air flow with a minimum of 10 air changes per hour. This means that 99.97% of an aerosol will be removed in 40 minutes. Further, all laboratory areas should be at negative pressure relative to the corridors at all times. Should the laboratory area revert to neutral or positive pressure, please notify the Laboratory Safety Branch for further guidance.

This biological spill response guide serves as a mechanism to familiarize the CDC laboratorians with the following information:

- Components of a Basic Spill Kit
- Response actions for a Biosafety Level 1 spill
- Response actions for a Biosafety Level 2 spill
- Response actions for a Biosafety Level 3 spill
- Response actions for a Biosafety Level 4 spill
- Incident reporting requirements
- Disinfectant guidance

As per the requirements of the CDC Comprehensive Emergency Management Plan, it is imperative that the CDC laboratorians become familiar with the procedures for managing the types of biological spills that may be found in their work place.

For further technical assistance concerning the information provided in this guidance document, contact the Laboratory Safety Branch, OHS, at (404)639-3238/ 2753.

Basic Spill Response Kit

- Disinfecting solution appropriate to infectious agent (see Disinfectants: See Table 1. Solutions should be freshly prepared.
- A bottle for solutions of disinfectant.
- Forceps or tongs, autoclavable broom and dustpan, or other mechanical device for handling sharps.
- Paper towels or other suitable absorbent.
- Biohazard bags for the collection of contaminated spill clean-up items.
- Waterproof utility gloves and latex or plastic examination gloves.
- Face protection (face shield or splash goggles and disposable respirator).
- Disposable scrubs.
- Spill sign to post on door to room.

Personal protective equipment, such as disposable lab coat, shoe covers, powered air-purifying (PAPR's) or full-face negative pressure respirators equipped with HEPA cartridges may also be required for spill response activities in Biosafety Level 3/3+.

As per the recommendations in *Biosafety in Microbiological and Biomedical Laboratories, 4th Edition,* spills of infectious materials at Biosafety Levels 3 and 4 are to be managed by appropriate professional staff or others properly trained and equipped to work with concentrated infectious material. The Laboratory Safety Branch, OHS, should be notified immediately at (404) 639-3238/2753.

Sodium hypochlorite solutions are recommended as the standard disinfectant in this spill response guide. Readily available sources of sodium hypochlorite are proprietary products, reagent grade chemicals, or household chlorine bleach. Other disinfectants may be more appropriate due to their effectiveness with certain etiologic agents. Proper use conditions (i.e. concentrations, contact time) are described in detail for each Biosafety Level strategy. Refer to the section on "Disinfectants" for further guidance.

Biosafety Level 1 (BSL1) Spill Protocol

Note: Most, if not all, of the infectious agents worked with at Biosafety Level 1 are not transmitted via aerosols. Respiratory protective equipment may not be needed during spill management procedures at this level

1. Notify others in the area, to limit potential of further contamination to additional personnel or the environment.

2. Remove any contaminated clothing and lab coats. Wash exposed skin with antiseptic soap and water. Launder conntaminated clothing/ lab coats in hot water with bleach.

3. Don appropriate personal protective equipment (PPE): gloves, lab coat, and splash goggles.

4. Cover spill with paper towels, and carefully pour a sodium hypochlorite solution containing 5000-6000 parts per million (ppm) [see the "Disinfectants" section for instructions on preparing use solutions of sodium hypochlorite] or other appropriate disinfectant on the towels and around the spill allowing it to mix with the material. If using proprietary disinfectant product, follow the manufacture's instructions for proper use concentration and contact time. When using sodium hypochlorite fot his initial decontamination step, allow a contact time of 20 minutes.

5. Using forceps or tongs, pick up any pieces of broken glass and place them in a sharps container. Placeforceps in discard pan for autoclaving.

6. Carefully pick up the absorbent toweling and the bulk of the spill material and discard these into a biohazard bag. Use fresh toweling to wipe up any residual material and discard along with the other disposable materials.

7. Clean the surface with an EPA-registered detergent/ disinfectant and allow to air dry. Alternatively, clean the surface with detergent and water, followed with an application of 500-600 ppm sodium hypochlorite solution. Allow to air dry.

8. Remove disposable gloves and discard as biohazardous waste. Discard any disposable protective clothing used during spill clean-up. Clean and disinfect utility gloves, face shield, goggles, and any other reusable protective equipment used during spill clean-up.

Biosafety Level 1 (BSL1) Spill Protocol

9. Wash hands with antiseptic soap and water.

10. Dispose of biohazardous waste in accordance with CDC decontamination procedures.

Notify immediate supervisor, and the Laboratory Safety Branch (404-639-3238/2753) as soon as possible of the incident to ensure that it is reported and medically managed in accordance with CDC injury/incident reporting requirements.

Biosafety Level 2 (BSL2) Spill Protocol

Spill Outside a Biosafety Cabinet:

DO NOT USE BLEACH SOLUTIONS ON IODINATED MATERIAL, RADIOIODINE GAS MAY BE RELEASED. USE AN ALTERNATIVE DISINFECTANT SUCH AS AN IODOPHOR OR PHENOLIC.

1. **EVACUATE ROOM**. Avoid inhaling airborne material, while quickly leaving the room. Notify others to leave the room. Close the door and post a warning sign for no entry. Allow a minimum of 30 minutes for the air

2. Remove contaminated clothing and/or lab coat, turning exposed areas inward, and place in a biohazard bag.

3. Wash all exposed skin with antiseptic soap and water. If there has been an exposure to the eyes, flush eyes for a minimum of 15 minutes and report to the Occupational Health Clinic for further medical evaluation.

4. Inform supervisor, and consult the LSB at (404) 639-3238/2753 for assistance. Consult with LSB to determine who will decontaminate the spill. A serious spill may need to be decontaminated by LSB personnel.

5. **DECONTAMINATE THE AREA**. Assemble clean-up materials to include appropriate personal protective equipment, disinfectant, paper towels, biohazard bags, forceps and sharps container if necessary.

6. Allow air handling system to remove aerosols for at least 30 minutes prior to reentering laboratory with clean-up materials and personal protective equipment (PPE) to manage the spill. (If the spill occurs in a common area such as a corridor or elevator lobby, alert others to stay away from the area and notify the Laboratory Safety Branch for assistance.)

7. Don protective clothing (disposable lab coat, gown or jump suit, splash goggles, disposable respirator, utility gloves or double gloves, and booties if necessary). Depending on the nature of the spill and mode of transmission, it may be necessary for LSB personnel to wear a HEPA-filtered respirator rather than a disposable respirator.

Biosafety Level 2 (BSL2) Spill Protocol

8. Cover spill with paper towels, and carefully pour a sodium hypochlorite solution containing 5000-6000 parts per million (ppm) [see the "Disinfectants" section for instructions on preparing use solutions of sodium hypochlorite] or other appropriate disinfectant on the towels and around the spill allowing it to mix with the material. If using proprietary disinfectant product, follow the manufacture's instructions for proper use concentration and contact time. When using sodium hypochlorite fot his initial decontamination step, allow a contact time of 20 minutes

9. Pick up any sharp objects with forceps or other mechanical device (tongs, autoclavable broom and dustpan, plastic scoops, two pieces of cardboard, etc.) and discard in a sharps container.

10. Soak up the disinfectant and spill, and place material into a biohazard bag or sharps container. Since smaller pieces of broken glass may not be visible avoid wiping the floor or work surface directly with the hands. Use a thick wad of paper towels to wipe the work surface, or push paper towels into a dustpan with a piece of cardboard.

11. Clean the surface with an EPA-registered detergent/disinfectant and allow to air dry. Alternatively, clean the surface with detergent and water, followed with an application of 500-600 ppm sodium hypochlorite solution. Allow to air dry. Wipe surrounding areas where the spill may have splashed with towels soaked in disinfectant.

12. Keep personnel out of the spill area or post with a "Spill Clean-up In Progress" sign if you leave the room while clean-up is under way.

13. Place all contaminated paper towels and any contaminated protective clothing into a biohazard bag and autoclave as per CDC decontamination procedures.

14. Wash hands and exposed skin areas with antiseptic soap and water.

Biosafety Level 2 (BSL2) Spill Protocol

Spill in a Biosafety Cabinet

Do not use sodium hypochlorite solutions on the metal surfaces in the cabinet because of the corrosive nature of these solvents. Use either a phenolic or an iodophor at proper use concentrations. Alcohol is not recommended because of it's explosive potential.

1. Leave the biosafety cabinet turned on and begin clean-up immediately.

2. While wearing PPE (gown and gloves) cover the spill area with plastic-backed towels or disinfectant-soaked towels. Do not place your head inside the cabinet to clean the spill. Keep your face behind the front view screen. If necessary, flood the work surface, as well as the drain pans and catch basins below the work surface, with disinfectant.

3. Spray or wipe cabinet walls, work surfaces, and inside the front view sash with disinfectant. After 20 minutes of contact time, soak up the disinfectant and discard the absorbant materials into a biohazard bag.

4. If the spill requires flooding the drain basin, DO NOT ATTEMPT TO CLEAN UP OR DRAIN. Consult with LSB about possible gas decon.

5. Autoclave all clean-up materials and protective clothing. Wash hands and exposed skin areas with antiseptic soap and water.

6. Notify your immediate supervisor of the spill. The LSB should be notified if the spill overflows into the interior of the cabinet. It may be necessary to perform a more extensive decontamination of the cabinet.

Biosafety Level 3 (BSL3) Spill Protocol

Use the following guidelines for response actions to spills of BSL3 materials outside of the biosafety cabinet or any other incident that may have generated an aerosol in the containment laboratory, such as failure of physical containment devices during centrifugation.

1. **EVACUATE ROOM**. Avoid inhaling airborne material. Notify others in the room, and evacuate immediately. Post spill warning sign. Allow a minimum of 30 minutes for the air handling system to eliminate aerosols.

2. Remove personal protective equipment in the airlock or access zone. Turn potentially contaminated clothing inward; remove gloves last. Wash any exposed skin areas with antiseptic soap and warm water.

   Exposure Incidents:

   - Needlestick/puncture wound: wash the affected area with disinfectant, antiseptic soap and warm water. Squeeze around the area to encourage the flow of blood out of the wound. Report to the Occupational Health Clinic.

   - Mucous membrane exposure: use an eyewash for a minimum of 15 minutes to flush the affected area. Report to the Occupational Health Clinic.

3. Notify your supervisor and the LSB at (404) 639-3238/2753. LSB will determine whether they or program personnel under LSB supervision will clean up spill.

4. **DECONTAMINATE THE AREA**. Only re-enter the laboratory after it has been cleared for reentry by the laboratory supervisor and the LSB. In general, a period of at least 30 minutes should be allowed before clean-up is attempted. The time is contingent upon the supply and exhaust features of the laboratory.

5. Don appropriate PPE (lab coat, gloves, eye protection and, if appropriate, respiratory protection) and enter the lab. Cover the spill area with disinfectant-soaked towels.

Biosafety Level 3 (BSL3) Spill Protocol

6. Cover spill with paper towels, and carefully pour a sodium hypochlorite solution containing 5000-6000 parts per million (ppm) [see the "Disinfectants" section for instructions on preparing use solutions of sodium hypochlorite] or other appropriate disinfectant on the towels and around the spill allowing it to mix with the material. If using proprietary disinfectant product, follow the manufacture's instructions for proper use concentration and contact time. When using sodium hypochlorite fot his initial decontamination step, allow a contact time of 20 minutes

7. While waiting, clean and decontaminate the surrounding floor and work surface areas where splashes or larger aerosols may have settled around the spill. Use disinfectantowels to wipe these areas When using proprietary disinfectants, follow the manufactures instructions. If using sodium hypochlorite solutions, a 500-600ppm solution following cleaning of the surface should be sufficient. Let air dry.

8. After the 20-minute contact time, place soiled paper towels inside the biohazard bag.

9. After performing the decontamination, decontaminate any durable, heat-stable reusable items such as forceps by autoclaving.

10. Remove PPE, turn any exposed areas inward and place in the biohazard bag. Generally, gloves should be removed last. To avoid touching your face with gloved hands, remove gloves just before removing respirator or eyewear. Wipe down the exterior portions of any reusable PPE such as PAPR and utility gloves . Use a disinfectant that is compatible with the materials present in the PPE Perform the disinfectant wipe down twice.

11. Wash your hands well with antiseptic soap and water.

12. Autoclave all waste generated from the spill clean-up. Use fresh gloves for transport to the autoclave, and wash hands after removing gloves.

Centrifuge Decontamination Protocol

1. When centrifuging infectious agents, utilize sealed tubes and either a sealed rotor or safety buckets for containment. Ensure that all O-rings or gaskets are in place and in good condition prior to use.

2. Wait 5 minutes before opening the centrifuge following the end of a run with potentially hazardous biological material.

3. If centrifuge contamination is identified after the lid is opened, carefully close the lid, and **evacuate the laboratory** for at least 30 minutes. Post a warning sign on the laboratory door.

4. In the event of an incident during centrifugation, turn off the centrifuge, leave the lid closed, and evacuate the laboratory. Allow aerosols to settle for at least 30 minutes. Post a warning sign on the laboratory door.

5. Remove any contaminated protective clothing and place it in a biohazard bag. Wash hands and any exposed skin surfaces with soap and water.

6. Notify your supervisor and the LSB.

7. **DECONTAMINATE THE AREA** after 30 minutes. Enter the laboratory with personal protective equipment and spill clean-up materials. Full face protection, a lab coat and utility gloves should be worn. LSB may also recommend that a respirator be worn.

8. Transfer rotors and buckets to a biological safety cabinet. Immerse in 70% ethanol or a non-corrosive disinfectant effective against the agent in use. A one-hour contact time is recommended. Uncapped or unbroken tubes may be wiped down with disinfectant after the soak and placed in a new container. Handle broken glass with forceps and place in sharps container.

Centrifuge Decontamination Protocol

9. Carefully retrieve any broken glass from inside the centrifuge with forceps and place in a sharps container. Smaller pieces of glass may be collected with cotton or paper towels held between the forceps. Carefully wipe the inside of the centrifuge with papers towels soaked in an appropriate disinfectant. Spray the inside of the centrifuge with an appropriate disinfectant and allow to air dry. Avoid the use of sodium hypochlorite if at all possible because of the corrosive nature of sodium hypochlorite solutions. If sodium hypochlorite solutions are used, rinse thoroughly with copious amounts of water

10. Place contaminated items and disposable personal protective equipment in a biological waste bag and autoclave.

11. Wash hands with antiseptic soap and water.

Biohazardous Radioactive Material Spill Protocol

Biohazardous spills that involve radioactive material require emergency procedures which are different from the procedures used for either material alone. It is necessary to use procedures which protect you from the radiochemical while you disinfect the biological material.

Before beginning the clean-up, consider the type of radionuclide, characteristics of the microorganism, and the volume of the spill. Contact the Radiation Safety Section, OHS, at (404) 639-3145 for isotope clean-up concerns.

DO NOT USE BLEACH SOLUTIONS ON IODINATED MATERIAL, RADIOIODINE GAS MAY BE RELEASED. INSTEAD, USE AN ALTERNATIVE DISINFECTANT SUCH AS AN IODOPHOR OR PHENOLIC.

1. **EVACUATE ROOM**. Avoid inhaling airborne material. Notify others in the area to leave the room. Leave the room, close the door, and post a warning sign.

2. Remove any contaminated clothing, turn exposed areas inward, and place in a biohazard bag.

3. Wash exposed skin with antiseptic soap and water, followed by a 3-minute water rinse.

4. Inform supervisor and Radiation Safety Officer of spill. Monitor all exposed personnel for radiation. If assistance is needed in handling the biological agent involved, contact the LSB, at (404) 639-3238/3145.

5. **DECONTAMINATE THE AREA**. Allow air handling system to remove aerosols for at least 30 minutes prior to entering the laboratory to clean the spill. Assemble clean-up materials to include disinfectant, autoclavable containers, forceps or tongs, towel, sponges. Confirm with the Radiation Safety Office that it is safe to enter the lab.

Biohazardous Radioactive Material Spill Protocol

6. Don protective clothing (lab coat, surgical mask, gloves, and shoe covers). Depending on the nature of the spill, it may be advisable to wear a HEPA-filtered respirator instead of a surgical mask.

7. Cover the affected area with disinfectant-soaked towels and carefully pour disinfectant from the outside perimeter of the spill to the center of the spill. Avoid enlarging the contaminated area. Use more concentrated disinfectant as it is diluted by the spill. Allow at least 20 minutes contact time.

8. Handle any sharp objects with forceps. Wipe surrounding areas where the spill may have splashed with disinfectant.

9. Soak up the disinfectant and spill, and place the decontaminated waste, along with all contaminated protective clothing, into an approved radiation container. Label it according to Radiation Safety guidelines.

   DO NOT AUTOCLAVE the waste unless this action is approved by the Radiation Safety Officer, (404) 639-3145. If it cannot be autoclaved, add additional disinfectant to ensure decontamination of all the materials.

10. Wash hands and exposed skin areas with antiseptic soap and water, and monitor personnel and spill area for residual radioactive contamination.

    If residual radioactive contamination is found on the skin, repeat decontamination procedures under the direction of the Radiation Safety Officer.

    If the spill area has residual activity, determine if it is fixed or removable and handle it in accordance with recommendations of the Radiation Safety Officer.

    Contaminated protective clothing must also be decontaminated prior to disposal as radioactive waste. Decontaminate as follows:

    a. Place the contaminated item(s) on absorbent paper.

    b. Spray disinfectant on the contaminated areas and allow 20 minutes contact time.

    c. Wrap the item(s) inside the paper and dispose of as radioactive waste.

Biohazardous Chemical Spill Protocol

Biohazardous spills that involve hazardous chemicals require emergency procedures which are different from the procedures used for either material alone. It is necessary to use procedures which protect you from the hazardous chemical while you disinfect the biological material.

Before beginning the clean-up, consider the type of chemical, characteristics of the microorganism, and the volume of the spill. Contact the Environmental Protection Section, OHS, at (404) 639-3417 for hazardous chemical clean-up concerns.

In general, protect yourself from the exposure to hazardous chemicals first. Then clean up the biological spill. Follow the decontamination procedures for the biological agent according to this guide. Clean up the chemical spill using the procedures and materials found in the green chemical spill kits located near the laboratories.

1. **EVACUATE ROOM**. Avoid inhaling airborne material. Notify others in the area to leave the room. Leave the room, close the door, and post a warning sign.

2. Remove any contaminated clothing, turn exposed areas inward, and place in a biohazard bag.

3. If body has made contact with corrosive materials rinse with eyewash or emergency shower for 15 minutes, or, if appropriate, wash exposed skin with antiseptic soap and water, and rinse with water for 3 minutes. Then go immediately to the Occupational Health Clinic.

4. **DECONTAMINATE THE AREA**. Allow air handling system to remove aerosols for at least 30 minutes prior to entering the laboratory to clean the spill. Assemble clean-up materials to include disinfectant, autoclavable containers, forceps or tongs, towel, sponges.

5. Don personal protective clothing as recommended by the hazardous material Material Safety Data Sheet (MSDS) or as recommended by the OHS staff (lab coat, disposable respirator, gloves, shoe covers, etc). Depending on the nature of the spill, it may be advisable to wear an appropriate filtered respirator instead of a surgical mask. Employees must be fit tested and certified before wearing a respirator.

Biohazardous Chemical Spill Protocol

6. Test a small section of affected area with disinfectant to ensure hazardous material isn't reactive with disinfectant. If reactive, change disinfectants. If not reactive, cover the affected area with disinfectant-soaked towels and carefully pour disinfectant from the outside perimeter of the spill to the center of the spill. Avoid enlarging the contaminated area. Use more concentrated disinfectant as it is diluted by the spill. Allow at least 20 minutes contact time.

7. Handle any sharp objects with forceps. Wipe surrounding areas where the spill may have splashed with disinfectant.

8. Soak up the disinfectant and spill, and place the decontaminated waste, along with all contaminated protective clothing, into an approved container.
   DO NOT AUTOCLAVE the waste unless this action is approved by the Environmental Protection Section (404) 639-3417. If it cannot be autoclaved, add additional disinfectant to ensure decontamination of all the materials.

9. Wash hands and exposed skin areas with antiseptic soap and water.

Incident Reporting Procedure

Prompt response is extremely important following laboratory exposures.

1. Treat the injured area: wash with disinfectant or antiseptic soap and warm water.

   For **NEEDLESTICKS AND PUNCTURE WOUNDS**: squeeze around the injury to encourage the flow of blood out of the wound.

   For **SPLASHES TO THE FACE** (mucous membranes of eyes, nose and mouth): use the eyewash for 15 minutes to flush the exposed area.

2. Notify your supervisor (if available);
   call or have someone call the LSB, (404) 639-3238/2753;
   report to the Occupational Health Clinic.

3. Ensure incident report, CDC Form 0.304, is filed with the Occupational Health Clinic, It can be found on the OHS website at:
   http://intranet.cdc.gov/ohs/PDFFILES/0304.pdf

Commonly Recommended Disinfectants for Use in CDC/ATSDR Infectious Disease Laboratories

Four Most Commonly Recommended DISINFECTANTS for Use in CDC/ATSDR Infectious Disease Laboratories

NOTE: Any mention of trade names is for identification purposes only and is not intended as an endorsement. Proprietary disinfectant products should be used in accordance with the manufacturer's instructions for concentration, contact time, or other conditions of use.

1. **CHLORINE COMPOUNDS**. Powerful germicides with a wide spectrum of activity, lack of toxic residuals, and low cost. Like other halogens, they are highly reactive with organic matter and must be used either on a clean surface or in high concentrations. They are corrosive to metals, and rinsing is necessary when using concentrated solutions. Sodium hypochlorite solutions possess intermediate-level disinfectant properties, including some sporicidal activity against bacterial spores such as *Bacillus anthracis*. Commonly available sources of sodium hypochlorite solutions are proprietary products, household chlorine bleach, and reagent grade chemical. Sodium hypochlorite solutions are excellent laboratory disinfectants for incubators, tabletops, and laboratory spills. When using proprietary versions of sodium hypochlorite solutions, please read and follow label instructions for use carefully. Proprietary products may be more highly concentrated compared to household chlorine bleach, which in the U.S. is typically available at a concentration of 5.25% free available chlorine. **NOTE: 5.25% chlorine is equivalent to 52,500 parts per million (ppm).** If household chlorine bleach is used, two working solutions are generally recommended: 5000 - 6000 ppm for initial decontamination of organic spill material, and 500 - 600 ppm for disinfection of cleaned surfaces. The directions for preperation of these solutions are listed on the following page. These dilutions are adequate for decontaminating surfaces with blood or other potentially infectious material. For maximum potency, the working solutions should be prepared fresh at the time of use or daily as needed. *Coxiella burnetii*, the causative agent of Q fever, is not inactivated by 5% Clorox or Alcide (10:1:1) after 24 hours of contact time at room temperature.

Commonly Recommended Disinfectants for Use in CDC/ATSDR Infectious Disease Laboratories

To prepare a 5000 - 6000 ppm solution from a 5.25% bleach solution:

English: Add 1¼ c. (12.8 oz.) bleach to 1 gal. of water (128 oz.), or
¾ c. (6 oz.) bleach to 2 qts. of water (64 oz.), or
_ c. (3 oz.) bleach to 1 qt. of water (32 oz.).

Metric: Add 500 mL bleach to 4500 mL of water, or
50 mL bleach to 450 mL of water, or
5 mL bleach to 45 mL of water.

To prepare a 500 - 600 ppm solution from a 5.25% bleach solution:

English: Add ¼ c. (2 oz.) bleach to 1 gal. (128 oz.) of water

Metric: Add 50 mL bleach to 4950 mL of water, or
5 mL bleach to 495 mL of water.

2. **ALCOHOLS.** In concentrations of 70 to 90%, alcohols are an excellent disinfectant of intermediate germicidal activity. Isopropyl alcohol is widely used as an antiseptic and for rapid decontamination of small objects. It does not inactivate picornaviruses, whereas ethyl alcohol does. Alcohols can form flammable mixtures with air and should be used with care for surface disinfection in closed areas, such as biological safety cabinets. For emergency disinfection of certain items, immersion in 75-90% ethyl alcohol for 15 minutes is recommended. *Coxiella burnetii* is inactivated by either 70% ethyl alcohol or 5% chloroform after a contact time of 30 minutes.

Commonly Recommended Disinfectants for Use in CDC/ATSDR Infectious Disease Laboratories

3. **PHENOLIC COMPOUNDS**. These compounds, derived from coal tar, were first used as wound dressings, but today have a wide use as general disinfectants. Examples are 'Lysol' (cresol and soap solution) and 'Stericol' (xylenol-rich cresylic acid and soap solution), both of which are active against viruses and bacteria but less active against bacterial spores. They are particularly effective for lipid-enveloped viruses. Working solutions of phenolics at pH 8 or below are most effective against microorganisms. However, treatment of *Coxiella burnetii* with a 5% solution of Lysol failed to inactivate after 24 hours at 25^0 C.

4. **QUATERNARY AMMONIUM COMPOUNDS**. This category of compounds has been found to be highly effective against an extremely wide range of microorganisms, including gram positive and gram negative bacteria, fungi and some viruses. Quaternary ammonium chlorides are odorless and have low oral toxicity and skin irritation at concentration of 400-500 ppm of quaternary used for disinfection. The germicidal activity of quats increases as the pH increases. Commercially available Enviro-Chem (N-akyl dimethyl benzyl and ethylbenzal ammonium chlorides) at a 5% solution will inactivate *Coxiella burnetii* within 30 minutes at 25^0C.

Table 1 - Disinfectants and Agent Decontamination

	Use parameters				Effective against					Important characteristics						
	Conc. of active ingredients	Temp (°C)	Relative humidity (%)	Contact time (min)	Vegetative bacteria	Lipo viruses	Tubercle bacilli	Hydrophilic viruses	Bacterial spores	Inactivated by organic matter	Residual	Corrosive	Skin irritant	Eye irritant	Respiratory irritant	Toxic (absorbed or ingested)
Autoclave-15 lb/in²	Saturated steam	121		50-90	P	P	P	P	P							
Autoclave-27 lb/in²	Saturated steam	132		10-20	P	P	P	P	P							
Dry-heat oven		160-180		180-240	P	P	P	P	P							
Incinerator	Heat	649-926		1-60	P		P	P	P							
UV radiation (253.7 nm)	40 μW/cm²			10-30	P		P	LP		P			P	P		
Ethylene oxide	400-800	35-60	35-60	105-240	P	P	P	P	P		P		P	P	P	P
Paraformaldehyde (gas)	0.3g/ft³	>23	>60	60-180	P	P	P	P	P		P			P	P	P
Vaporized hydrogen peroxide	2.4 mg/L	4-50	<30	8-60	P	P	P	P	P			P	P	P	P	
Quaternary ammonium compounds	0.1-2%			10-30	P	P				P						P
Phenolic compounds	0.2-3%			10-30	P	P	P	LP		LP	P	P	P	P	LP	P
Chlorine compounds	0.01-5%			10-30	P	P	P	P	LP	P	LP	P	P	P	P	P
Iodophor compounds	0.47%			10-30	P	P	P	LP		P	P	P	P	P		P
Alcohol (ethyl or isopropyl)	70-85%			10-30	P	P	P	LP		P				P		P
Formaldehyde (liquid)	4-8%			10-30	P	P	P	P	LP		P		P	P	P	P
Gluteraldehyde	2%			10-600	P	P	P	P	P		P		P	P	P	P
Hydrogen peroxide (liquid)	6%			10-600	P	P	P	P	P		P	P	P	P		

P = very positive; LP = less positive. A blank denotes a negative response or not applicable.

Table 1 - Disinfectants and Agent Decontamination

	Applications																				
	Work surface maintenance	Floor maintenance	Biohazard spill, floor surfaces	Safety cabinet surface maintenance	Safety cabinet biohazard spill	Safety cabinet total decontamination	Large area and air systems decontamination	Water baths	Contaminated liquid-discard	Infectious laboratory waste	Contaminated glassware	Contaminated instruments	Equipment surfaces	Equipment total decontamination	Floor drains	Animal injection site	Contaminated animal bedding	Infected animal carcass	Microbial transfer-loop	Books, paper, shoes	Electrical instruments	Lensed instruments
Autoclave-15 lb/in²									P	P	P	LP					P	LP				
Autoclave-27 lb/in²									P	P	P	LP					P	LP				
Dry-heat oven											LP	LP					LP					
Incinerator										P							P	P	P			
UV radiation (253.7 nm)				LP																		
Ethylene oxide											LP	LP		LP						P	P	
Paraformaldehyde (gas)						P	P							P							P	
Vaporized hydrogen peroxide						P								P								
Quaternary ammonium compounds		P	LP	P	LP			LP			P		P		P							
Phenolic compounds		P	P		P			P	P	P	P	P	P		P							
Chlorine compounds			P		P			LP			P	P	P		P							
Iodophor compounds			LP	P	LP			P			P		P									
Alcohol (ethyl or isopropyl)			LP	P				LP					P			P						
Formaldehyde (liquid)			LP						LP	LP	LP	LP	LP									
Gluteraldehyde											P	P	P								LP	
Hydrogen peroxide (liquid)											P	P	P									

P = very positive; LP = less positive. A blank denotes a negative response or not applicable.